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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/847,479	05/02/2001	Jeffrey J. Brown	FIS920010077US1	6231

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EXAMINER

BARRECA, NICOLE M

ART UNIT PAPER NUMBER

1756

DATE MAILED: 12/10/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/847,479

Applicant(s) **SK**

BROWN ET AL.

Examiner

Nicole M. Barreca

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) 12 and 16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-11 and 13-15 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☒ Claim(s) 1-16 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-11, 13-15, drawn to a method for making a semiconductor device, classified in class 430, subclass 311.
 - II. Claims 12, 16, drawn to a method for controlling line width variation tolerances for isolated and nested features, classified in class 216, subclass 59.
2. The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as subcombinations disclosed as usable together in a single combination. The subcombinations are distinct from each other if they are shown to be separately usable. In the instant case, invention II has separate utility such as a method for controlling the line width variation tolerances of isolated and nested features during the manufacture of a semiconductor device using a single etch step (i.e. in the absence of a (first) trim etch step). See MPEP § 806.05(d).
3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.
4. During a telephone conversation with Jim Cioffi on 12/5/02 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-11, 13-15. Affirmation of this election must be made by applicant in replying to this Office action.

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Claims 12, 16 are withdrawn from further consideration by the examiner, 37

CFR 1.142(b), as being drawn to a non-elected invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 2, 4, 7, 11, 13-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Tao (US Patent 6,235,440).

8. Tao discloses a method to control critical dimension (CD) of a pattern using a resist trim. A photoresist is coated over a hard mask layer such as silicon dioxide. All line widths in the original pattern are increased by a fixed amount and a pattern is formed in the photoresist using this modified data. The lines are then ashed in order to trim or reduce the photoresist lines into the desired CD range by controlling the parameters, such as etching time, for the etching process. A typical trimming process

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would be a Cl₂/O₂ mixture at 200-300 Watts. The hard mask layer is then etched using the trimmed resist pattern as a mask, followed by etching of the polysilicon layer to form the gate (col.3, 11-col.4, 31).

9. Claims 1, 2, 4, 5, 7, 9, 11, 13-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Yang (US Patent 6,372,651).

10. Yang discloses a method for trimming a photoresist pattern line for memory gate etching. A resist mask pattern 74 is formed overlying antireflective coating 72 on a semiconductor wafer. The sidewalls of the resist mask pattern are etched or trimmed to reduce the line pattern width. Following the etching of resist mask pattern lines the antireflective (SiON) coating layer 72 is etched using the trimmed resist pattern as an etching mask in a plasma etch chamber in a gas mixture of CHF₃, CF₄, O₂ and Ar. Layers 70 (polysilicon cap), 68 (silicide), 66 (second polysilicon), 64 (oxide-nitride-oxide) and 62 (first polysilicon) are successively etched using the antireflective layer as a mask (col.5, 5-31).

11. Claims 1, 2, 4, 7, 11, 13-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Yang (US Patent 6,107,172).

12. Yang discloses a method for controlling the line width reduction during gate pattern formation. Initial resist mask 20 has an initial line width, which is wider than the desired gate to be formed (col.3, 55-65). The trim etch process preferably using one of three gas mixtures, one mixture which includes N₂, He and O₂ (col.4, 17-22). In certain embodiments the power is approximately 150-400 Watts and the pressure is maintained between approximately 20-150 mT (col.4, 28-33). The BARC layer 16 and gate

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conductive layer 14 are etched using the pattern of the final resist mask 22 (col.4, 45-65).

13. Claims 1, 2, 4, 7, 11, 13-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Chen (US 6,283,131).

14. Chen discloses a method for patterning a polysilicon layer using a resist trim. Resist layer 80 is provided over the silicon dioxide layer 76. The first recipe step comprises the trim etch. The trimming etch recipe comprises a combination of gases including HBr (60-100 sccm), Ar (40-80 sccm) and O₂ (2-10 sc.). The chamber pressure is between about 5-15 mT, a source power of 200-400 Watts and a bias power between 40-80 Watts. Following the trim etch the hard mask layer 72, along with silicon dioxide layer 76 are etched using for example CF₄ (10-30 sccm) and Ar (140-160 sccm) (col.4, 37-col.5, 30).

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 3, 5, 6, 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tao or Chen as applied to claim 1, 4, or 7, respectively above, and further in view of Jang (US Patent 5,940,719).

17. Tao and Chen do not disclose that the (first) trim etch is a oxygen and nitrogen plasma etch with a flow rate of oxygen to nitrogen between 0.25 and 2.5, a RF power of

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50-200 Watts and a pressure of 10-45 mT. Tao and Chen also do not disclose that the second oxide etch is performed using 20-80 sccm of CF₄, 5-15 sccm of CHF₃ and 40-200 sccm of Ar. Jang teaches that etch recipes factors including the kinds, ratio and pressures of the etch gases and power are varied depending on the etch time (col.5, 44-47). It would have been obvious to one of ordinary skill in the art that the flow gas ratio of oxygen to nitrogen, the RF power and pressure of the trim etch, and the composition and flow rate of the second oxide etch, could be varied depending on the etch time desired because Jang teaches that the kinds, ratio and pressures of the etch gases and power of the etching gases is a result-effective variable which will depend on the etch time. It would have been within the ordinary skill of one in the art to use a flow ratio of oxygen to nitrogen of between 0.25 and 2.5 and to use a RF power of 50-200 Watts and a pressure of 10-45 mT for the trim etch and to use 20-80 sccm of CF₄, 5-15 sccm of CHF₃ and 40-200 sccm of Ar for the second etch, if the desired etch time required such an etch recipe. See *In re Boesch*.

18. Claims 3 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang (US Patent 6,107,172) as applied to claim 1 or 7, respectively above, and further in view of Jang (US Patent 5,940,719).

19. While Yang '172 teaches using a trim etch process preferably using a gas mixture of N₂, He and O₂, as well as etching at a power of approximately 150-400 Watts and a pressure between approximately 20-150 mT, the reference is silent on the flow ratio of oxygen to nitrogen and does not disclose that the flow ratio is between 0.25 and 2.5. Jang teaches that etch recipes factors including the ratio of the etch gases are

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varied depending on the etch time (col.5, 44-47). It would have been obvious to one of ordinary skill in the art that the flow gas ratio of oxygen to nitrogen could be varied depending on the etch time desired because Jang teaches that the ratio of the etching gases is a result-effective variable which will depend on the etch time. It would have been within the ordinary skill of one in the art to use a flow ratio of oxygen to nitrogen of between 0.25 and 2.5, if the desired etch time required. See *In re Boesch*.

20. Claims 6 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen as applied to claim 5 or 9, respectively above, and further in view of Bothra (US 2001/0009792).

21. While Chen does disclose etching silicon dioxide layer 76 using CF₄ (10-30 sccm) and Ar (140-160 sccm), the references does not disclose that the second oxide etch is performed using 20-80 sccm of CF₄, 5-15 sccm of CHF₃ and 40-200sccm of Ar. Bothra teaches a preferred plasma etch recipe for etching a silicon dioxide layer which uses 40-200 sccm of Ar , 4-20 sccm of CF₄ and 15-60 sccm of CHF₃ (table 2, col.5). Therefore it would have been obvious to one of ordinary skill in the art to etch the silicon dioxide layer of Chen using 40-200 sccm of Ar , 4-20 sccm of CF₄ and 15-60 sccm of CHF₃ because Bothra teaches that this is a preferred etch chemistry for etching a layer of silicon dioxide.

Conclusion

22. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Groechal (US Patent 5,021,121) teaches an RIE process for etching a silicon oxide layer using CHF₃, Ar, and minor amounts of CH₄. Gariel (US


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2002/0139773), Aminpur (US Patent 6,482,726), Ng (US 2002/0142252) and Yu (US Patent 6,368,982) teach methods for manufacturing a semiconductor device using a trim etch step. Brown (US 2002/0164546) is the Patent Application Publication for the present application.

23. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 703-308-7968. The examiner can normally be reached on Monday-Thursday (8:00 am-6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.



nmb

December 5, 2002